Insects and the Prairie

Insects are the dominant life form on earth. Millions may exist in a single acre of land. About one million species have been described, and there may be as many as ten times that number yet to be identified. Of all creatures on earth, insects are the main consumers of plants. They also play a major role in the breakdown of plant and animal material and constitute a major food source for many other animals.

Insects are extraordinarily adaptable creatures, having evolved to live successfully in most environments on earth, including deserts and the Antarctic. The only place where insects are not commonly found is the ocean. If they are not physically equipped to live in a stressful environment, insects have adapted behaviors to avoid such stresses. Insects possess an amazing diversity in size, form, and behavior.

It is believed that insects are successful because they have a protective shell or exoskeleton, they are small, and they can fly. Their small size and ability to fly permits escape from enemies and dispersal to new environments. Because they are small they require only small amounts of food and can exist in very small niches or spaces. In addition, insects can produce large numbers of offspring relatively quickly. Insect populations also possess considerable genetic diversity and a great potential for adaptation to different or changing environments. This makes them an especially formidable pest of crops, able to adapt to new plant varieties as they are developed or rapidly becoming resistant to insecticides.

Insects are directly beneficial to humans by producing honey, silk, wax, and other products. Indirectly, they are important as pollinators of crops, natural enemies of pests, scavengers, and food for other creatures. At the same time, insects are major pests of humans and domesticated animals because they destroy crops and carry diseases. In reality, less than one percent of insect species are pests, and only a few hundred of these are consistently a problem. In the context of agriculture, an insect is a pest if its presence or damage results in an economically important loss.

It has been estimated that there are around 850 different plant species that are indigenous to the prairies of Illinois. At the same time the estimated number of insect species is 5,100. Most of the prairie forbs depend on butterflies, moths, beetles, and bees for pollination. The monarch has a special affection for the milkweed, the painted lady prefers the thistle flower and the brightly colored soldier beetle seeks out the goldenrod.

Composites, such as the coneflower, daisy, dandelion, and compass plant are easily pollinated by a large variety of insects. The composite is the most abundant flower family on the prairie and attracts the widest range of insect visitors.

Pollinator guild is the term used to describe the group of species that pollinate a particular plant. Pollinator guilds can be composed of a particular group of organisms, such as bees, or can be a mix of several groups, such as flies and beetles. In the case of prairie plants, knowledge of the members of these pollinator guilds is limited. Even less

information is available about how these guilds have changed over time. Changes in pollinator guilds can have a negative impact on the reproductive success of a species. In a study of the pale spiked lobelia in northern Illinois at the Midewin National Tallgrass Prairie, a comparison was made between the current pollinator guild, which consists of only four types of bees, and a study done in the 1930's at a prairie some 10 miles from the site of the Midewin. It was determined that only 1 of the species recorded in the 1930's study is still part of the present pollinator guild for the lobelia at the Midewin. The conclusion was made that, for the pale spiked lobelia, the pollinator guild is quite small and further loss of prairie habitat could have a negative impact on the plant.

Some prairie flowers are very particular; and are pollinated by a single insect species. "The western prairie fringed orchid stands as on of the gems of North America's remaining tallgrass prairies. This flowering orchid may grow up to 4 feet tall, and have up to two-dozen white to creamy white fringed flowers. The plant does not attract insects during the day. At night the orchid's flowers increase their fragrance to attract the roaming long-tongued hawkmoth (Family Springidae: species Xylophanes Tersa). This species of moth has a uniquely evolved tongue for harvesting the orchid's nectar. The orchid's white-fringed petals direct approaching moths to the spur and the plentiful supply of nectar it holds. As the moth hovers with its long tongue extended into the spur, two specialized pollen-bearing structures brush pollen onto the eyes of the moth.

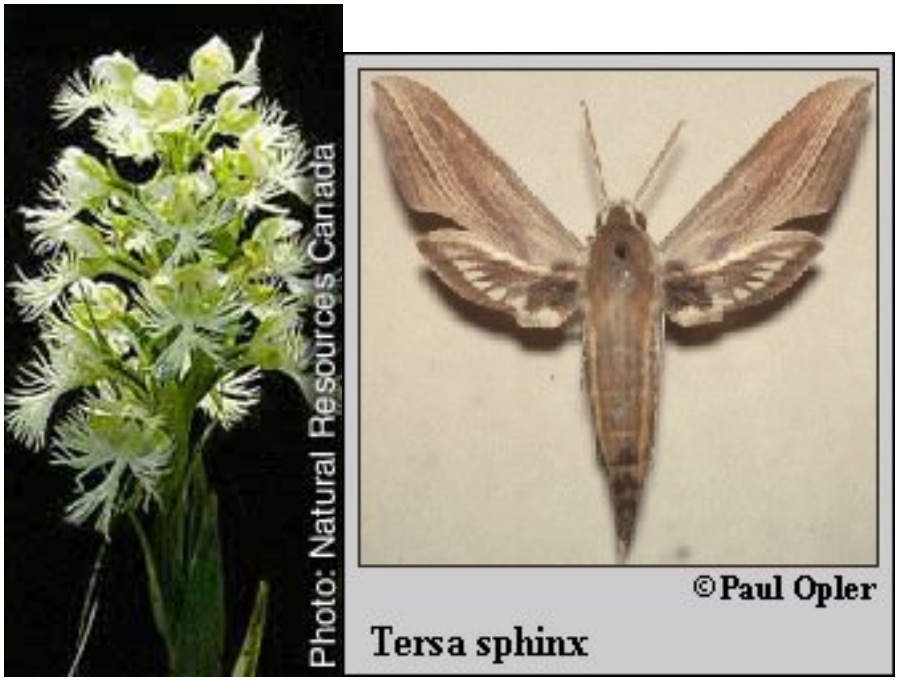
The western prairie fringed orchid nectar spur is the longest of any North American orchid. Only those species of hawkmoths with suitable length tongues and properly spaced eyes can act as pollinators.

After attaching to the eyes, the pollen may be deposited upon the next orchid flower the moth visits. This transfer of pollen among orchids results in fertilization and ultimately the production of seeds.

Due to loss of prairie habitat, the orchid was listed as a threatened species under the Endangered Species Act. The fragmented prairie remnants and restorations pose the greatest obstacle for these insect-oriented orchids. The expanses of cropland act as a barrier for free movement of hawkmoths between different orchid populations, reducing genetic diversity of isolated stands. Pesticide drift from nearby cropland also poses a threat to non-targeted insects such as the hawkmoth. In some areas, hawkmoths numbers are so depleted that only a very small percentage of flowers are pollinated and produce seed.

Approximately a quarter of known western prairie fringed orchid sites are protected in preserves or other publicly managed areas. Land managers are concentrating their efforts on meeting the needs of the orchid through long-term management plans. Providing hawkmoth "corridors" of native prairie between orchid populations could offset the immediate threat that faces isolated populations. However, some orchid preserves are isolated tens or even hundreds of miles apart. For these secluded populations, pollinating the plants by hand can buy the orchid some time.

Long-term survival of this tallgrass gem requires not only protecting its habitat but also insuring the survival of the orchids only means of reproduction, the long-tongued hawkmoth." U.S. Fish and Wildlife Service, Lakewood, CO Vol. II, No.4.



Pollination can be a bit of a challenge for some insects. Monarch butterflies and bumblebees are two of the most common insects visiting butterfly milkweed because they are strong enough to pull their legs free of the flowers' pollen traps. The bumblebee needs all of his strength when he visits the bottle gentian in the early fall. The gentian never entirely opens its beautiful flowers. The sepals are clamped together to form a swelling tube. The bumblebee, drawn to the gentian by his favorite color, blue, can enter the closed sepals by pressing on their apex, to which he is guided by the color pattern. However, it's a one-way entrance, opening only from the outside in. Any insect entirely within the blossom is likely to be trapped there. So the bumblebee pushes only the front half of his body into the gentian's "bottle," holding the entrance open behind him with his abdomen and rear legs. The gentian is dependent on the bumblebee for survival.


Bottle Gentian

Native bees are everywhere on the prairie. They number almost a thousand species. The black and yellow bumblebee nests in the ground. All native bees can sting, and unlike the honeybee, can withdraw their ovipositor after stinging and not die. The honeybee is not native to North America but was introduced by the early colonists. Bees may be the most important of all pollinators. This fact is extremely important to the science of prairie restoration.

With the resurgence of interest in the prairie heritage of Illinois, restoration projects are underway all over the state. They vary from small plots in back yards and school yards, to ribbons of rail road and highway right of ways, to large projects on public lands.

In order to insure the success of restoration projects, prairie plants need pollination for seed production. Seed production is essential for the prairie to become self-sustaining. Currently, invertebrates like bees are not a focus in prairie restoration and are left to colonize restored sites on their own. What, if any, are the consequences to a prairie restoration if this colonization does not occur? Not only are native bees beneficial to prairie plants, they also aid in pollinating agricultural crops. This is somewhat ironic, as agriculture is the main reason for the destruction of the prairie.

While there is now a great deal of information about the establishment of prairie plants, little is known about the establishment of prairie insects, including bees. At the present time scientists who study prairie restoration do not know the extent of bee colonization in restored prairies. They do know that the diversity of plants in a prairie is related to the diversity of insects and if prairie restoration is going to be successful diversity is the key.

What exactly is the relationship between the bee and the flower? The bee depends on the pollen and/or nectar for food; and the plants that are incapable of self-fertilization depend on the bees for pollination that leads to the production of seeds and the survival of the species. This is a mutualistic relationship, both parties benefit. Important bee pollinators are the bumblebee, miner, carpenter, leafcutter, and mason bees. These generalist bee species can fill the niche of pollinating most prairie forbs.

Because restored prairies are often isolated and fragmented, the possibility of a lack of pollinators is increased. Studies have shown that bumblebees, for example, were loyal to a particular site and did not forage into other areas because of barriers such as highways, railroads or agricultural fields.

There are steps that can be taken during and after a restoration to increase the rate of insect colonization on the site. Proper conditions for bee colonization can be provided in a new restoration site. Bees require: flowering plants that provide pollen and nectar, nesting cavities, and nesting materials such as animal fur and /or dead vegetation. All three requirements must be within flying distance of each other. Other bees require the presence of mud, resins, and pebbles for their nest construction. Bumblebee queens must locate a new nest in the spring to start their colony. Some common choices for underground sites are abandoned rodent or bird nests or other naturally occurring openings. Some bee species will nest above ground or near logs. Bumblebees are long

lived, therefore, a variety of plants that flower throughout the season from early spring to late fall is essential to keep the bee from seeking food elsewhere.

Native bee populations can be negatively affected by pesticide use in agricultural areas, competition by non-native honey bees, and by habitat loss. Pesticides can cause bee poisoning by drift, dust adherence to their bodies, by drinking contaminated water or by collecting contaminated pollen or nectar. Some pesticides can cause further harm to the whole colony when a contaminated bee returns to the hive. Examples of injurious pesticides, particularly during blooming periods, to bumblebees include diazinon, malathion and carbofuran. These are all important considerations for prairie restoration projects.

Native bees provide benefits to more than native plants. They also pollinate crops. The value of native pollinators to agriculture in the U.S. is estimated to be in the billions of dollars. Some scientists predict a crisis in agriculture due to lack of native bee pollination. Restored sites adjacent to agricultural areas could provide habitat for nests and forage for times when crops are not in bloom. By using native pollinators, the potential cost savings of reducing the need for honeybee hives could be in the tens of millions of dollars.

To maintain a high level of plant diversity in an ecosystem for the long term may require a high level of diversity of bee species. Restored prairie communities need efficient pollinators like native bees. Restoration efforts up to this point have not included the reintroduction of any insects. More research should be done in the area of bee –plant interactions and colonization to restored sites.

Traditionally, managers of prairie restorations have relied heavily on prescribed fire to encourage production and flowering of native grasses and forbs and to discourage growth of woody plants and invasive species. Although this method has had a dramatic positive impact on native plant diversity and structure in prairies, many entomologists question the assumption that prairie insects are adapted to fire and, thus, are not harmed by prescribed burns. Reports suggest that fire reduces insect abundance, species richness and diversity, other studies report that some species recover quickly from fire. Bumblebees, for example, nest underground and would not be adversely affected. The subject of the effects of fire on insect populations remains controversial, in part, because the factors that determine the rate of recovery of insect populations after fire are not well understood.

By late August there might be ten million insects in an acre of tallgrass prairie. Bees are not the only important insects. Two of the dominant orders are true bugs and flies, *Hemiptera* and *Diptera.*

The robber fly is the falcon of the insect kingdom, preying on other flying insects with amazing skill. There were certain “greenhead flies” in the prairie that drove men and livestock to the limits of their ability to survive life in the prairie.
Green headed flies can also be a problem today to people living near water.

Literature is rich with first and second hand accounts of the hardships on the lives of the early settlers of the prairie. One Illinois settler wrote home in 1821: "I have become acquainted this year with the prairie flies, about which I had heard so much. The smallest kind is a beautiful green about twice the size of a common housefly. Another kind is about twice as large as these, of a slate color. These, this season, in riding on the prairies, would entirely cover a horse and when fastened they remain until killed by smoke or by being skinned off by a knife, and then the horse will be covered with blood. The only way of riding a horse by day is by covering the animal completely." Madson, John. Where the Sky Begins: Land of the Tallgrass Prairie, 1982

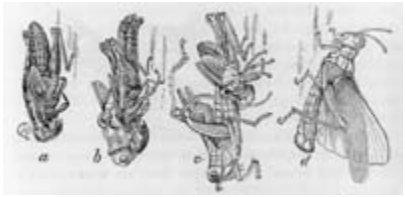
Of all of the insect groups on the prairie, none are more typical than the great order *Orthoptera,* which includes the grasshoppers. Kansas alone has 301 species of

grasshoppers. The Rocky Mountain Locust, a native of the high, dry grasslands at the foot of the Eastern Rocky Mountains, occasionally made its way to the tallgrass prairies of Iowa and Illinois. Because there are no scientific records dating back to the 1870's, we can't be positive of the reason, but, perhaps an unusually warm fall allowed long periods of egg laying. This was followed by a cool spring that delayed the hatch until there was adequate food for the young locusts. If this occurred for several consecutive years, the full reproductive potential of the insect was realized and the numbers were astronomical. Then something happened, something scientists cannot explain, transforming a rather sedentary insect and impelling it to swarm and travel. It was then that the Rocky Mountain locust, on long wings and riding the prevailing easterlies, came out of the Great Plains as a cloud of destruction.

A Nebraska witness to one of the great plagues estimated its magnitude. In places the locust swarm, measured with surveying instruments, was nearly a mile high—and swept into Nebraska on a 100-mile front that was 300 miles deep. With an estimate of twenty-seven grasshoppers per cubic yard, it was calculated that the living cloud contained twenty-eight million grasshoppers per cubic mile. The swarms persisted in that density for at least six hours at the observation point, moving eastward at about five miles per hour. There were thought to be over 124 billion locusts in the invasion.

"In the spring and summer of 1873, *Caloptenus Spretus,* or the Rocky Mountain locust, swept out of the foothills of the West to feed on the crops of the Plains states. For farmers, the grasshopper threat went beyond the damage done to crops that year. The seeds for future tragedy rested in the billions of eggs left behind in their fields. Young grasshoppers emerged about the time the wheat began to sprout. They devoured the young plants until their wings matured, and they were carried by the wind to devastate new fields--and lay more eggs.

There was little the farmers could do to combat the grasshopper plague. They tried using smoke, nets and newly invented hopperdozers to rid their fields of the insects and their eggs, but nothing was effective. Continued grasshopper damage pushed many farm families to the end of their means. Many men left their families to find work in areas unaffected by the plague or in lumber camps.



Other settlers eventually sought out private or public assistance. For farmers who prided themselves on their hard work and self-sufficiency, this was a difficult choice to make. One observer noted that many families were "taking every pain to conceal their real condition [and] they will not consent to receive any assistance till they approach the verge of starvation."

The scale of the devastation quickly strapped the charitable resources of communities and counties. State governments stepped in with limited relief appropriations that offered farmers seed loans and supplies. The federal government also authorized the army to distribute food and clothing to needy families.

In October 1876, a council of governors met in Omaha, Nebraska, to develop a coordinated response to the grasshopper problem. The council requested a federally funded investigation into the history and habits of the Rocky Mountain locust and search for all possible means of its extermination. In March 1877, a three-man entomological commission was established to assess the extent of agricultural losses and seek ways to prevent future infestations. Ironically, the commission established its St. Louis headquarters on Locust Street.

In the spring of 1877, the grasshopper plague eased. The yearly hatch of locusts still arrived, but they took wing without landing to lay eggs. A farmer in Minnesota noted that ‘a person could see little dark whirlwinds here and there, which after a while turned into dark clouds, and lo and behold, it was the grasshoppers leaving in the same manner as they had come years before.’" Scourge of the Prairie, The Locust Plague Tragedy, 1873-1878, The History Net.

Among the myriad of prairie insects the butterflies are the most beautiful. Many of the butterflies that you see visiting prairie forbs also visit the flowers in your back yard, however, as a result of the loss of prairie habitat there are species totally dependent on the prairie ecosystem that are candidates for listing under the Endangered Species Act.

The overwhelming destruction of prairie habitat has had disastrous consequences for prairie-specialist butterflies, not just because of the outright loss of appropriate living space but also because of habitat fragmentation. Because prairie-specialist butterflies are rarely encountered outside of these fragmented prairie patches, populations at different sites may have minimal gene flow and are rarely able to re-colonize sites of local extinctions. For example, the regal fritillary is the most widespread prairie butterfly species, but it requires larger habitat patches or connected networks of habitat patches to maintain populations.

Regal fritillaries mating on pale purple coneflower.

In order to preserve the integrity of the prairie ecosystem, simply planting a few species of prairie grasses and forbs and calling it a prairie restoration is not enough. Proper management of prairie burns and monitoring insect and plant species will help to ensure the success of a prairie restoration project.

Prairie Insects

Leaf cutter Bee

Description: 3/8-1/2" (10-12 mm). Black with long pale whitish-yellow hair, particularly below thorax and abdomen. Abdomen mostly bare, each segment narrowly fringed with whitish hair. Wings clear, veins black. Pollen brush below abdominal segments 2-5 is bright red.

Warning: As with all bee species, the females are capable of stinging when molested.

Food Adult drinks nectar of many flowers, especially composites. Larva feeds on nectar and pollen.

American Bumblebee ***Bombus pennsylvanicus***

Description: 7/8" (2 cm), Large, furry bee, banded with black and yellow; thorax and segments 1-3 of abdomen yellow; black behind wings. Wings are smoky. Queen is larger than workers.

Sword-bearing Conehead
(Neoconocephalus ensiger)

Interesting facts:
The ears of the Conehead grasshopper (and many other long-horned grasshoppers or katydids) are located at the top of the tibia (lower section) of each front leg. They can hear the sounds of some of their predators, such as the sounds put out by bats when they are trying to locate prey.

Description:
The sword-bearing conehead is a large, long-horned grasshopper. At night, the male makes chirping sounds by rubbing its wings together.

Dogbane Leaf Beetle
(Chrysochus auratus Fabricius)

Interesting facts:
The dogbane leaf beetle has a special type of color that shines and changes as the insect changes position or we change position looking at it. This changing color is called iridescence. The beetles' iridescence is produced by special body structures and light. The surface of the body parts of this beetle is made up of stacks of tiny, slanting plates, under which is a pigment (substance that produces color). Some light rays reflect from the surface of the plates, and other light rays reflect from the pigment underneath. At different angles, the light reflects at different speeds, causing interference and resulting in our seeing different colors that shine.

Habitat and behavior:
The female lays eggs on the ground or on the milkweed plant. The larvae tunnel through the soil to feed on the roots. Then they pupate in the soil.

Dogbane leaf beetles feed on prairie plants such as milkweeds *(Asclepias sp.)*, Indian hemp, and dogbane *(Apocynum sp.)*.

Handsome Grasshopper
(Syrbula admirabilis)

Interesting facts:
The ears on this species of grasshopper (and many other short-horned grasshoppers) are located on the sides of the abdomen, just behind the base of the hind legs. The ear looks like a tiny moveable drum head, but it can only be seen under a microscope.

Habitat and behavior:
Slant-face grasshoppers live in grasslands, wet meadows, and prairie remnants. Grasshoppers live for one season, from hatching in the spring until cold weather in the fall. Eggs are laid in the soil. They over-winter in the soil and hatch into nymphs in the spring. The nymph is a tiny version of the adult, but has no wings. It goes through five stages of growth, shedding its exoskeleton at each stage. At the end of two to three months, it is of adult size and has wings. A male and female mate and the female lays eggs in the soil. Then, the adults die.

Ambush Bug

Food: Flies, bees, butterflies, day-flying moths, and other true bugs.

Habitat: Gardens and meadows or prairies on flowers

Field Cricket
Gryllus pennsylvanicus

Food: Plant materials outdoors, including seeds and seedlings of wild and crop plants, small fruits, and when available, dying and dead insects.

Sound: Common song is a series of triple chirps. Courtship song is a continuous trill at a pitch near the upper limits of audibility for the human ear.

Life Cycle: Female inserts eggs singly deep into the soil. Eggs overwinter in the North, where all unmatured nymphs and adults die of the frost. In the South nymphs and adults may overwinter and produce 3 generations a year.

Carpenter bee *Xylocopa species*

Description: Carpenter Bees are members of the super family Apoidea. Bees form a large group of insects that are specialized for feeding at flowers and gathering honey and pollen. More than 3,500 species occur in North America. Bees, 1/8-1" (4-25 mm) long, may be black, brown, or banded with white, yellow, or orange. In many species the tongue is long and pointed, adapted for probing into flowers. All bees are covered with branched or feathery hair but some have more hair than others. When a bee visits a flower, pollen sticks to the hair. Most female bees have a pollen-collecting apparatus; males do not collect pollen and lack this structure.

Twelve Spotted Skimmer
Libellula pulchella

Behavior: Adult eats small insects caught in flight. Naiad feeds on aquatic invertebrates. Although the eggs are dropped into the water, the skimmer flies over the prairie to look for food.

Life Cycle Female drops eggs singly into water or settles on plants to attach eggs to stems close to water surface. Adults fly late May-September near the Canadian-United States border.

Praying Mantis
Mantis religiosa
European Mantid

Food: Diurnal insects, including caterpillars, flies, butterflies, bees, and some moths.

Life Cycle: Eggs overwinter in flat mass attached to exposed twigs above snow. They hatch almost simultaneously in late spring. Nymphs are dispersed by wind or eat one another. Survivors are solitary. 1 generation matures in late summer or early autumn.

Monarch Danaus *plexippus*

Discussion: One of the best known butterflies, the Monarch is the only butterfly that annually migrates both north and south as birds do, on a regular basis. But no single individual makes the entire round-trip journey. In the fall, Monarchs in the North begin to congregate and to move southward. Midwestern and eastern Monarchs continue south all the way to the Sierra Madre of middle Mexico, where they spend the winter among fir forests at high altitudes. Far western and Sierra Nevada Monarchs fly to the central and southern coast of California, where they cluster in groves of pine, cypress, and eucalyptus in Pacific Grove and elsewhere. Winter butterflies are sluggish and do not reproduce; they venture out to take nectar on warm days. In spring they head north, breed along the way, and their offspring return to the starting point. Both Mexican and international efforts are underway to protect the millions of Monarchs that

come to Mexico. In California, nearly all of the roosting sites face threatening development.

Eastern Tiger Swallowtail
Papilio glaucus

Life Cycle: Yellow-green, globular egg, 1/32" h x 3/64" w (0.8 x 1.2 mm), very large for a butterfly. Young caterpillar brown and white, resembling bird droppings; mature caterpillar, to 2" (51 mm), is green, swollen in front, with big, false, orange and black eyespots and band between 3rd and 4th segments. Mottled green or brown sticklike chrysalis, to 1 1/4" (32 mm), overwinters.

Discussion: This species is the most widely distributed tiger swallowtail, and one of the most common and conspicuous butterflies of the East. Alaskan, Canadian, and northeastern butterflies are smaller and paler than those of the eastern states. Feeding in groups, adults take nectar from a wide range of flowers.